



End-Use Efficiency

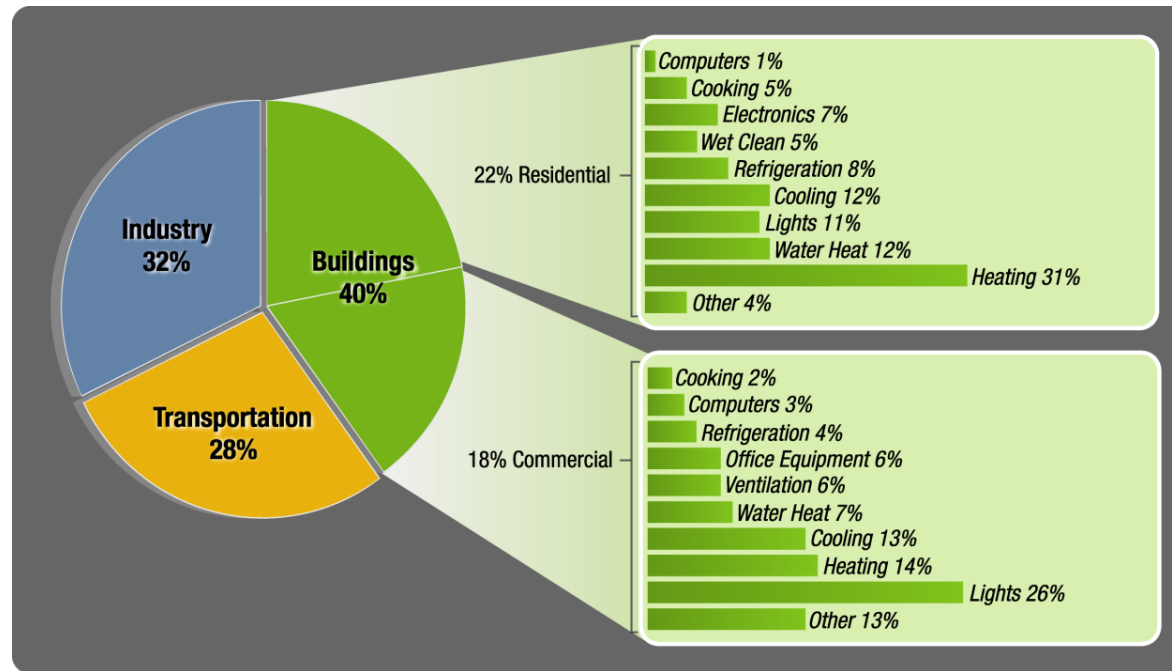
Overview and Building Efficiency

Ravi Prasher, Program Director

03/02/2011

Residential and Commercial Buildings Consume 40 Quads of Primary Energy Per Year

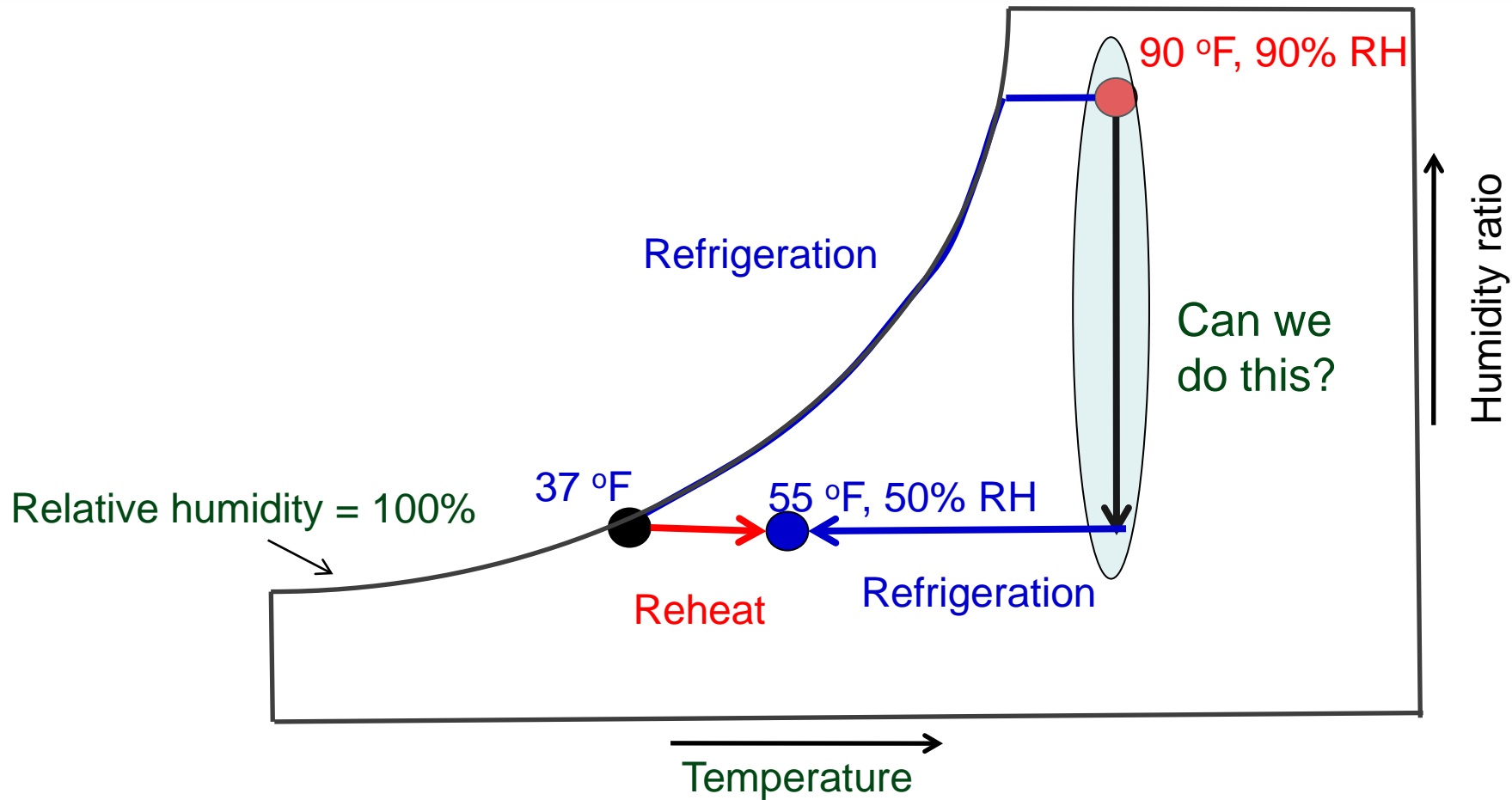
Buildings use 72% of the U.S. electricity and 55% of the its natural gas
Heating & cooling is ~50% of energy consumption



By 2030, Business as usual:
16% growth in electricity demand and additional 200 GW of electricity
(\$25-50 Billion/yr)

Source: LBNL Environmental Energy Technologies Division, 2009

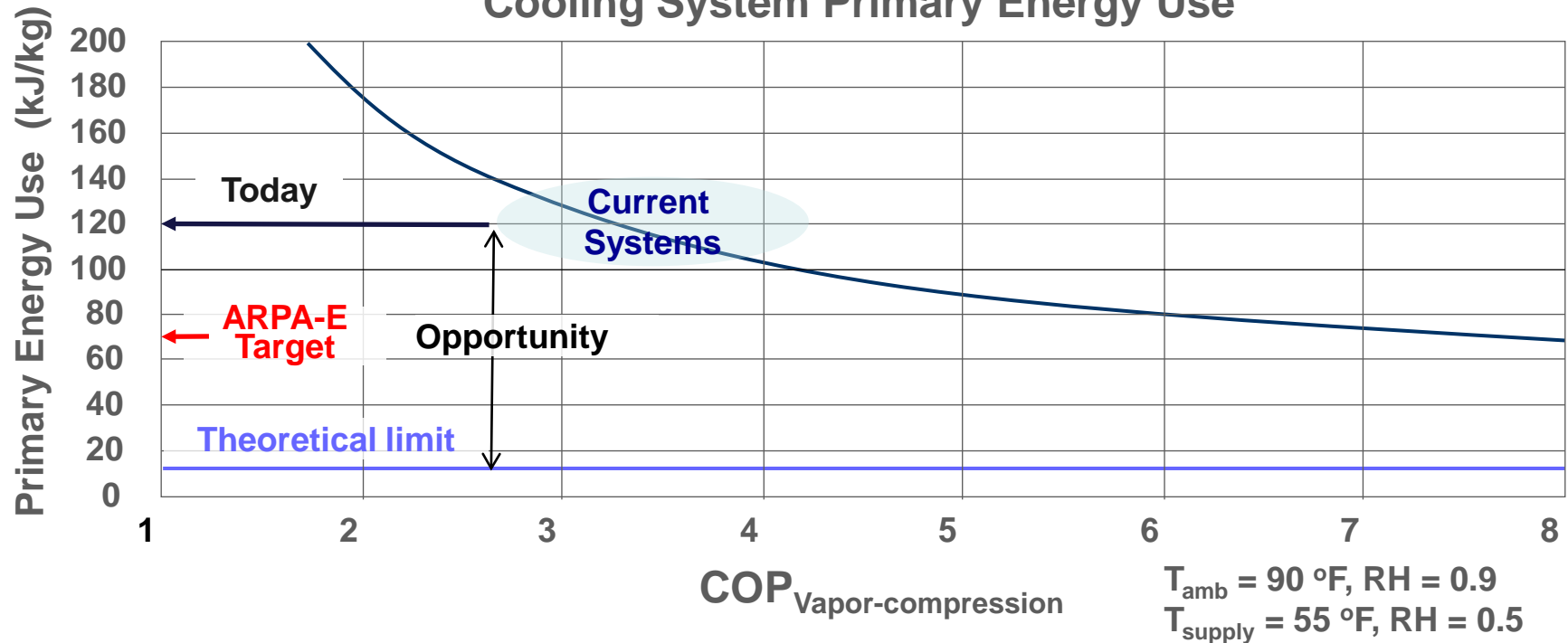
Current Cooling Practice



Building Energy Efficiency Through Innovative Thermodevices (BEETIT)

Building cooling is responsible for ~5% of US energy consumption and CO₂ emissions

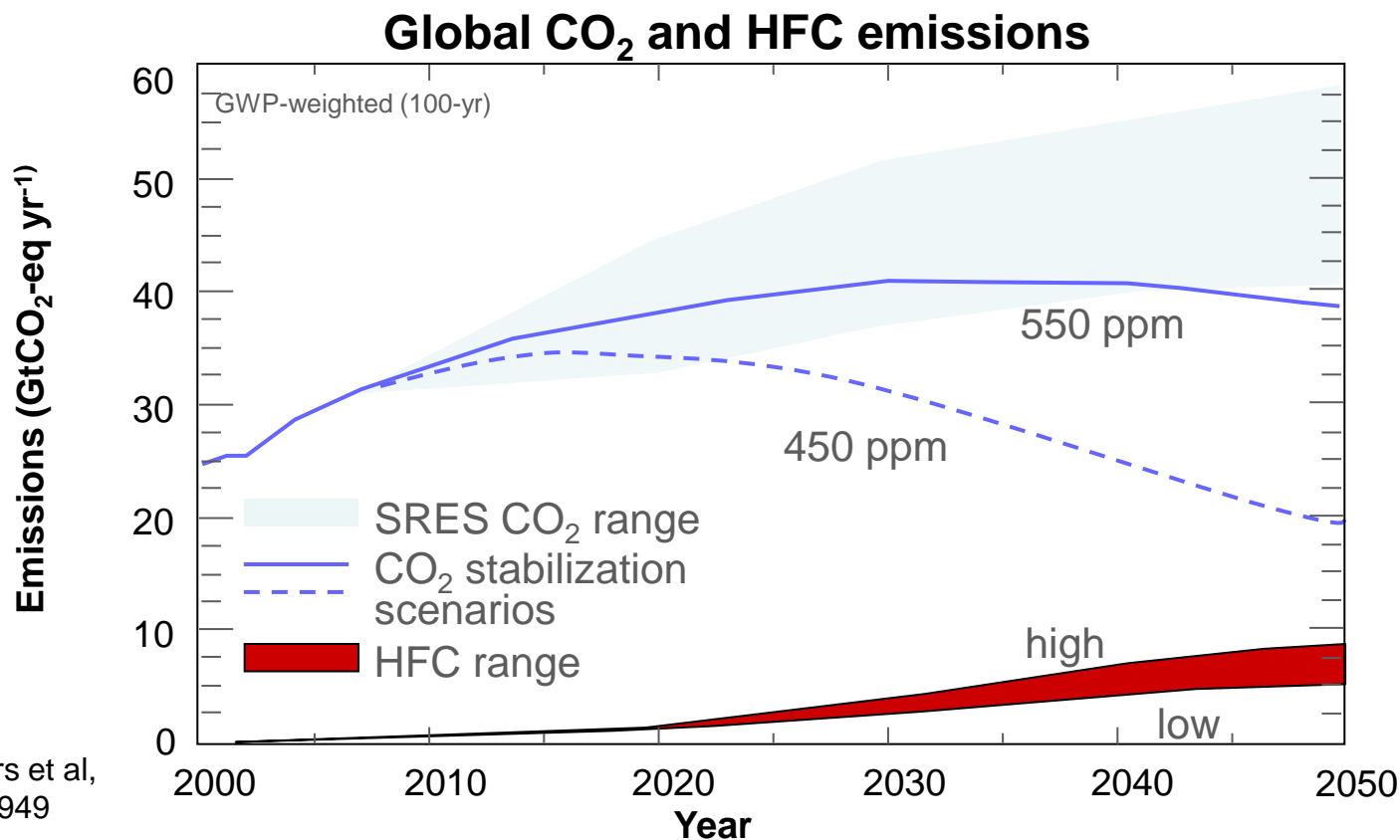
Cooling System Primary Energy Use



Reduce primary energy consumption by ~ 40 – 50%

Building Energy Efficiency Through Innovative Thermodevices (BEETIT)

Current refrigerants have a Global Warming Potential (GWP) 3000x greater than CO₂



Source: Velders et al,
PNAS 106, 10949
(2009)

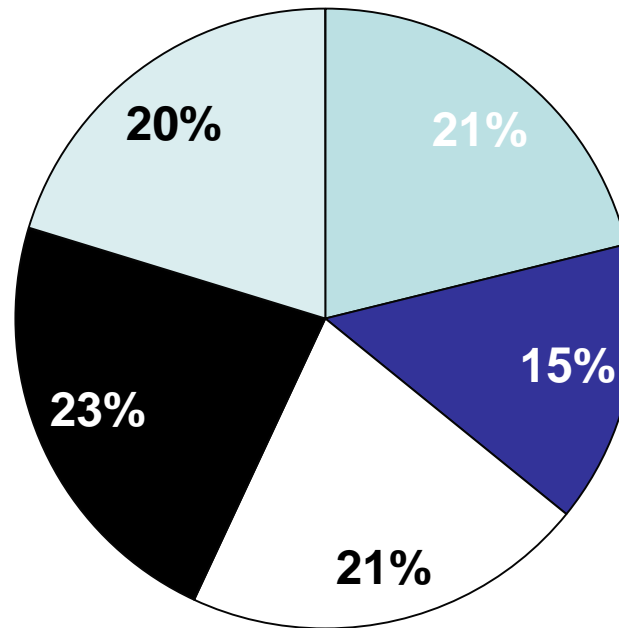
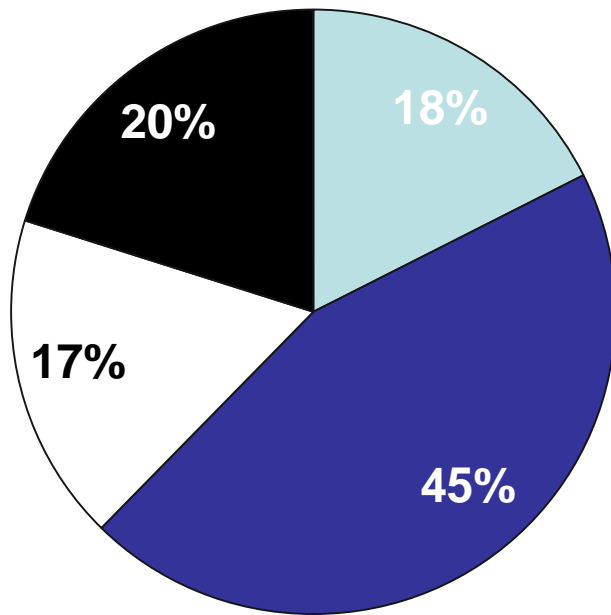
Achieve 1 ton of cooling using refrigerants with GWP ≤ 1

Portfolio of Technologies Funded

BEETIT: \$30.3 M, 3 years, 16 projects

Seedling
(<\$1 M)

Advanced Device Prototyping
(\$3-4 M)

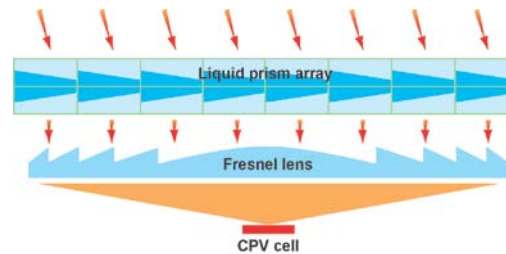


- Vapor Absorption/Adsorption
- Solid State Cooling
- Gas Cycles
- Dehumidification
- Mechanical Vapor Compression

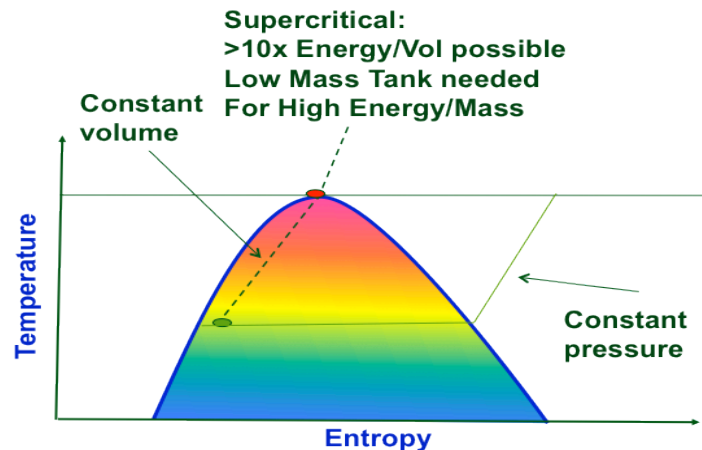
Portfolio of Technologies Funded

Two programs on solar also funded (~\$3.4 M)

- CPV : Optofluidic concentrator

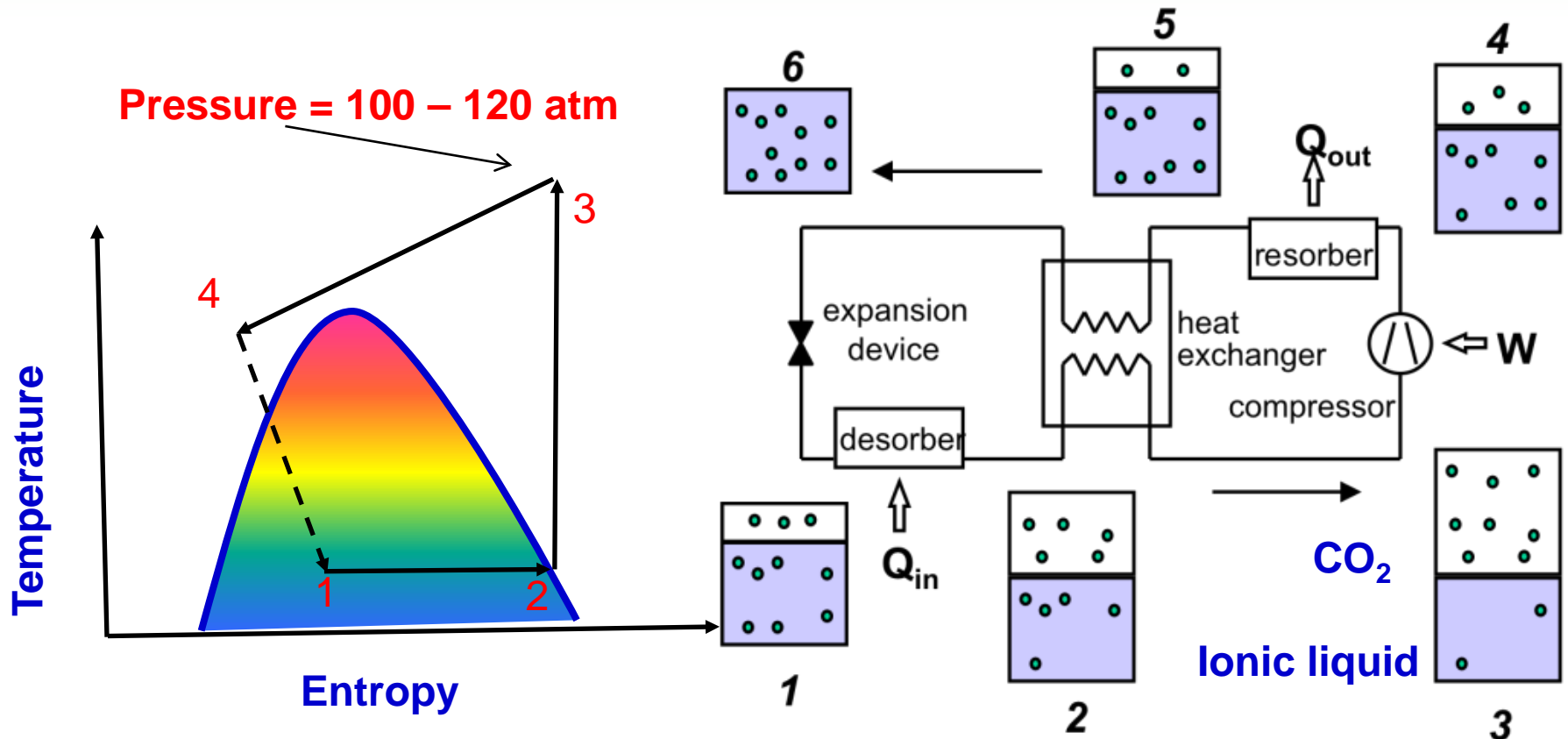


- Thermal storage for solar thermal



Compact, Efficient Air Conditioning with Ionic Liquid Based Refrigerants

University of Notre Dame, Dometic

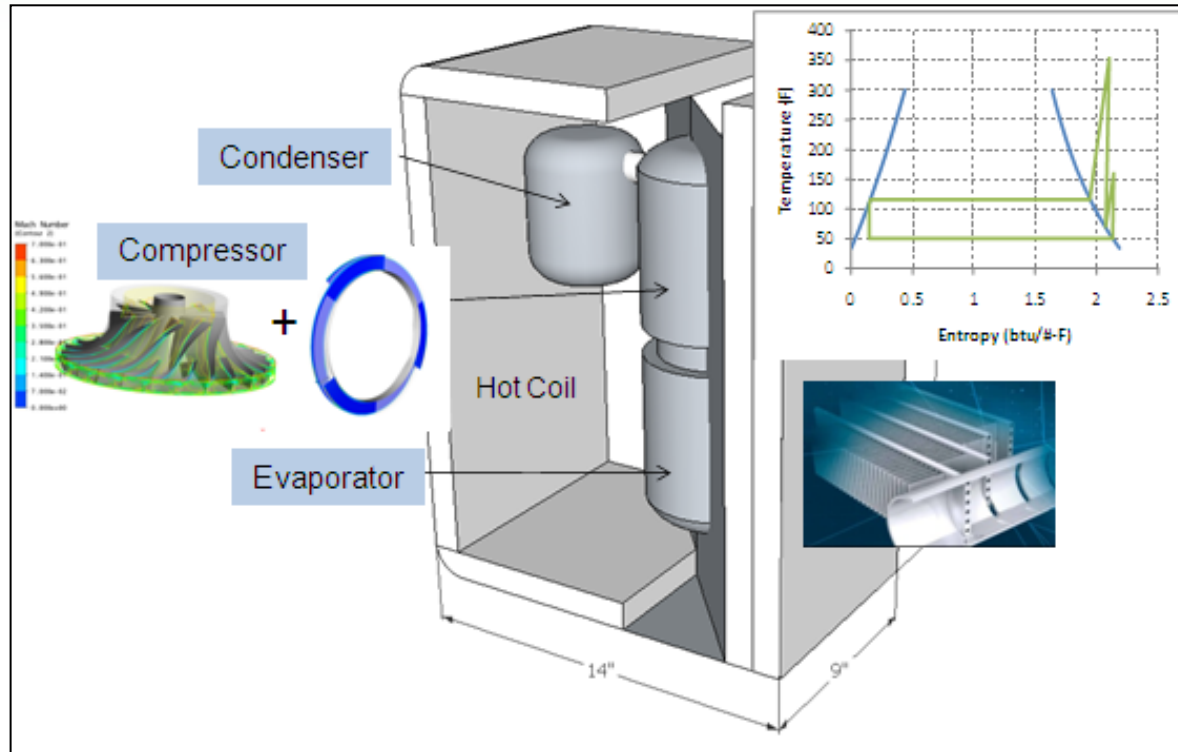


$$IL + CO_2 = (IL - CO_2) + \Delta h \quad \leftarrow \text{Tunable}$$

Use ionic liquid to decrease the pressure after the compressor

Water-Based HVAC System

UTRC

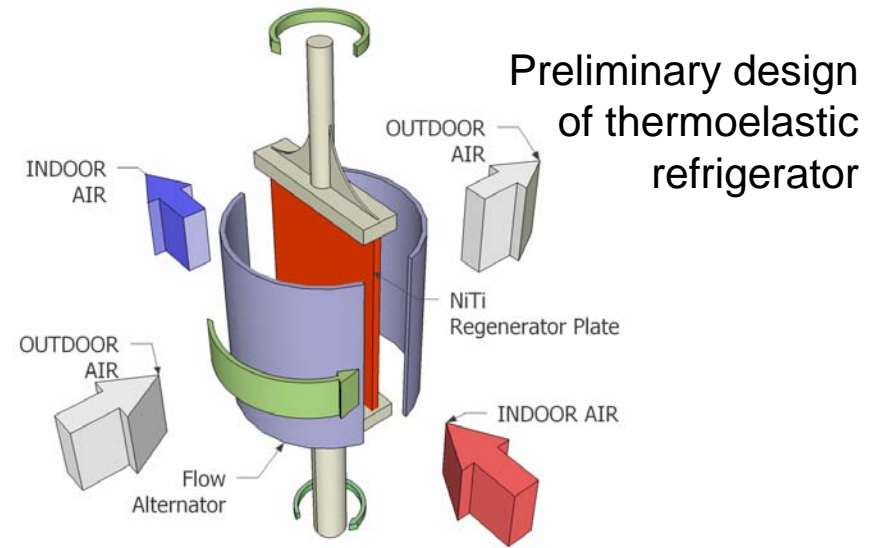
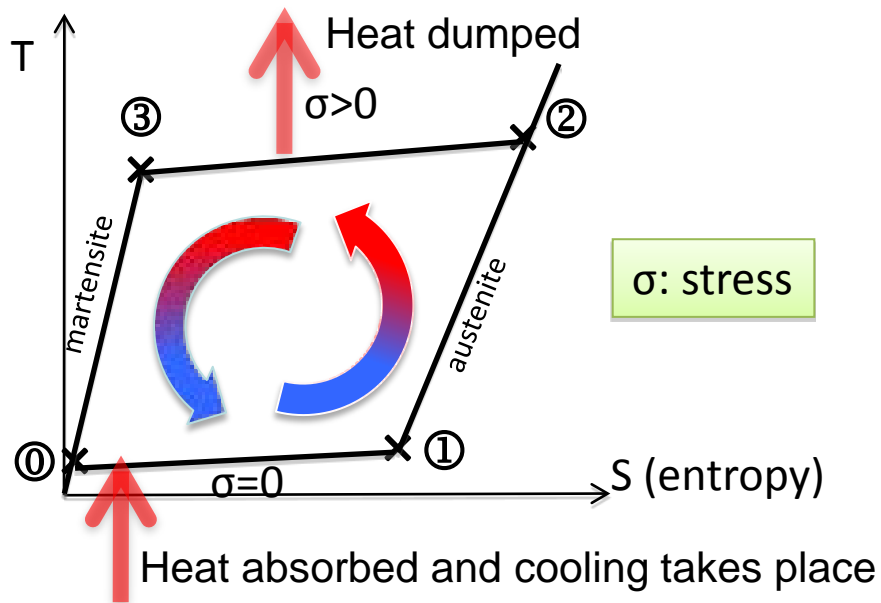


Supersonic compression that enables high compression ratio in a single stage

Non-Toxic, Non-Flammable Water as a Refrigerant in HVAC Systems

Thermoelastic Cooling

U. Maryland, PNNL & GE



Latent heat of martensitic transformation is used for cooling